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UDC 621.373.826.038.823

IGLAN-10 kW Multiple-Beam Continuous-Wave Technological CO_2 Laser

18620244B Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 7, Jul 89 pp 1360-1363

[Article by G. I. Kozlov and V. A. Kuznetsov, Institute of Problems in Mechanics, USSR Academy of Sciences, Moscow]

[Abstract] A multiple-beam continuous-wave technological CO_2-laser IGLAN-10 with a power rating of 10 kW has been developed and built for heat treatment of materials. Its power instability does not exceed three percent under normal operating conditions. Its starting and running performance is automatically controlled with the aid of a DVK-3 microcomputer. It was tested, by means of a movable diaphragm with small hole, for distribution of the radiation intensity in the beam. The beam was focused for this test by a KCl lens with a 160 mm diameter and a 110 cm focal length. The main feature which determines the performance of this laser is its rigid metal box which contains two arrays of 85 gas-discharge tubes also serving as waveguides in the cavity between two water-cooled plane mirrors, the opaque one made of Cu and the semitransparent one made of GaAs. The tubes, carefully separated from one another, are 2.3 m long (active discharge length 1.8 m) and have an inside diameter of 10 mm. The laser was pumped with d.c. discharge, the arc carrying a current of 20 mA under a voltage of 12 kV and a 300 kohm ballast resistance having been connected into the cathode circuit of each tube. As active medium was selected a CO_2:N_2:He = 1:1.8:5.6 gas mixture under a static pressure of 20 mm Hg, passed through the tubes by a vacuum pump capable of delivering 24 l/min but needing to deliver only 1 l/min of makeup mixture. Such an economy was achieved by providing for regeneration of the mixture in a closed gas cycle. The authors thank A. E. Abaliyev and V. A. Masyukov for fruitful collaboration. Figures 2; references 5: 4 Russian, 1 Western.

Modification of Wentzel-Kramers-Brillouin Method

18620233A Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 35 No 4, Jul-Aug 89 pp 577-583

[Article by A. S. Aralkin and N. Ye. Maltsev, Institute of Acoustics imeni N. N. Andreyev, USSR Academy of Sciences]

[Abstract] A modification of the Wentzel-Kramers-Brillouin method is proposed which facilitates obtaining simple asymptotic solutions to differential equations with inflection points. The second-order ordinary differential equation y"(x) plus $k^2Q(x)y(x)$ equal to 0 (k- large parameter) is considered, this equation being reducible to the Riccati first-order equation q^2- Q equal to $ik^{-1}dq/dx$ and then solvable asymptotically in W-K-B approximations. In order to avoid approximations with poles at an inflection point where x is 0, both sides of the Riccati equation are multiplied by $q^2(x)$ (the superscript plus or minus having been dropped, inasmuch as $q^+(x)$ is equal to $[q^-(x)]^*$) and the second-order differential equation is thus transformed into a fourth-order differential one. Discarding the small term $i/6k^{-3}d^3q/dx^3$ reduces this differential equation to a quartic algebraic one. This modification of the W-K-B method is compared with the modification which involves transforming the second-order differential equation into a cubic algebraic one (multiplying both sides of the Riccati equation by q(x), then discarding the small term $i/2k^{-2}d^2q/dx^2$). A numerical analysis of solutions based on the two modifications with the exact solution in Airy functions indicates that the error of the quartic approximation is much smaller than that of the cubic one, especially at an inflection point where x is 0 and the error of the conventional W-K-B method is infinitely large. Figures 1; tables 1; references 3: Russian.

UDC 535.375:621.373.826

Accuracy of Correction of Spherical Aberration in Focused Beams by Phase Conjugation During Stimulated Brillouin-Mandelshtam Scattering

18620244A Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 7, Jul 89 pp 1405-1411

[Article by V. V. Kraynov, A. A. Mak, and V. Ye. Yashin]

[Abstract] Correction of spherical aberration in focused beams by phase conjugation during stimulated Brillouin-Mandelshtam scattering is evaluated for accuracy, correction of smooth phase aberrations having already been studied and found to be difficult owing to the nonuniform distribution of pumping power density over the interaction space. An experiment was performed using a conventional two-pass scheme with four-wave decoupling, a beam of narrow-band 1055 nm radiation emitted by a Nd-laser in pulses of 30 ns duration above half-amplitude level passing through a set of aberrator lenses on the first pass and then being focused by a lens into a $TiCl_4$ low-threshold scatterer cell from which it exited on the second pass. The aberrator lenses were made of isotropic glass heat-treated either by irradiation with a graded intensity profile or by the diffusion method. Two kinds of aberrators were thus produced, radiation which has passed through the central zone focusing respectively nearer or farther than radiation which has passed through the peripheral zone. Their refractive index profile was varied over a wide range appreciably deviating from a parabolic one and was monitored with a Mach-Zehnder interferometer. Photographs and measurements reveal that the accuracy of aberration correction by this method depends on both amplitude and type of distortion, both determined by the path of the radiation beam in the scattering medium. The accuracy was found to be improved by "noising" the beam with small-scale phase distortions and its subsequent spatial filtering.

Using an etched plate or a screen with aberrators of the second kind was found to lower the accuracy of correction, but converting aberrations of the first type into aberrations of the second type by means of an additional corrective element was found to improve the accuracy of subsequent correction. The authors thank V. M. Mitkin for supplying the aberrators, also V. V. Lyubimov and K. V. Gratsianov for supplying the screen. Figures 6; tables 1; references 12: Russian.

UDC 621.373.826.038.825.4

Generation of Ultrashort Light Pulses in Semiconductor Laser With Dual Feedback

18620221A Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 6, Jun 89 pp 1116-1121

[Article by K. B. Dedushenko and S. A. Yegorov, Moscow Institute of Engineering Physics]

[Abstract] A generator of picosecond light pulses has been developed on the basis of a semiconductor injection laser with optical as well as optoelectronic feedback. Optical feedback is provided through an external cavity, while optoelectronic feedback is provided by a photodiode which picks up some of the laser output radiation and feeds a current signal through an amplifier back into the active medium. The laser operates with active mode locking, the compression of light pulses depending on their travel time across the external cavity relative to the signal delay time in the optoelectronic feedback loop. The performance characteristics of this laser are evaluated theoretically, assuming that it generates one longitudinal mode and one transverse mode in the main inner cavity with negligible spontaneous emission. The corresponding system of two equations for the rates of change of electron and photon concentrations is linearized, its characteristic equation being a transcendental one solvable with the aid of the Nyquist diagram. Two experimental oscillators were built according to this principle, each with a GaAlAs double-heterojunction laser and an LFD-2A avalanche photodiode for optoelectronic feedback. The first one with almost sinusoidal feedback signal alone generated 50 ps light pulses. The second one in an external cavity formed by a dielectric high-reflectance mirror and a semiconductor exit mirror generated 11 ps light pulses, the pulse repetition rate depending on the adjustable length of this cavity. The authors thank Yu.A. Bykovskiy for attentiveness and for discussion of the results, A.N. Mamayev and I.V. Pasechnik for assistance in the experiment. Figures 5; references 15: 7 Russian, 8 Western.

UDC 621.373.826.038.823

Reflection of Radiation From XeCl-Laser by Aluminum Target Forming Erosional Plasma

18620221B Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 6, Jun 89 pp 1214-1220

[Article by V. P. Ageyev, A. A. Gorbunov, and V. I. Konov, Institute of General Physics, USSR Academy of Sciences, Moscow]

[Abstract] An experimental study was made concerning repetitive pulsed action of XeCl-laser radiation (wavelength 308 nm) on an aluminum target. The laser was pumped by electrical discharge and the target was made of extrahigh-purity aluminum. The target was mounted on the inside surface of a hollow sphere made of A5 aluminum, opposite a window through which the radiation after space-time processing by a lens-diaphragm-lens filter entered so as to impinge on the target at a 20 deg angle. A plane aluminum shield was also placed inside the sphere before another window so that radiation scattered upon interaction with the target would exit through this window after having been at least twice internally reflected by the spherical wall, the wall surface having been made diffusely reflective by pickling with lye. The optical properties of the aluminum target, absorption and reflection coefficients, were measured during action of successive radiation pulses. Its surface structure was measured under an electron microscope, the depth of craters being measured under a METAM P-1 optical one, after incidence of 20 radiation pulses on any one target surface segment. The readings indicate that the threshold power density for formation of erosional aluminum plasma remains 200 MW/cm^2 under vacuum and decreases, depending on the number of pulses down to 70 MW/cm^2 in air. Energy and mass balance in such an erosional plasma as well as its transmittance, temperature, and degree of ionization are estimated by evaluation of these data on the basis of applicable theoretical relations. Figures 5; tables 2; references 11: 6 Russian, 1 Bulgarian, 1 Romanian, 3 Western.

UDC 621.373.826

Destruction of Polymer Glasses During Scanning of Continuous-Wave Laser Beam

18620221C Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 6, Jun 89 pp 1221-1225

[Article by G. Ya. Glauberman, N. F. Pilipetskiy, S. Yu. Savanin, V. V. Shvedchenko, and V. V. Shkunov, Institute of Problems in Mechanics, USSR Academy of Sciences, Moscow]

[Abstract] An experimental study of laser beam scanning with polymer glass was made for an evaluation of the effects on such a glass. Discal specimens of polymethyl methacrylate, polystyrene, and polycarbonate were used for scanning the beam of an LTN-102V continuous-wave YAG-laser (wavelength 1,060 nm) with a power rating of 130 W in multimode operation, with power regulation by means of light filters, and with a total beam divergence of 0.008 rad at half-maximum intensity level. The laser radiation was focused by a lens onto a specimen which rotated at a constant speed while moving radially across the laser beam so as to become irradiated with pulses of increasing duration from the periphery toward the center. At a constant power density of 10^5 W/cm^2, breakdown of a specimen occurred at some spot after a certain time depending on the glass material. An analysis

of oscillograms and readings on the basis of given laser beam, lens, and glass parameters reveals that the probability of breakdown first increasing duration of exposure and then, after peaking after approximately 20 ms, decreases owing to thermal defocusing of the laser beam. There is, accordingly, a certain scanning rate associated with earliest breakdown of polymer glass. Faster scanning was found to cause predominantly brittle fracture, traces of absorption waves and no cracks having been found after slower scanning with attendant defocusing of the laser beam. Figures 7; references 6: 5 Russian, 1 Western.

Generating High-Power Pulses of Tunable Ultraviolet Radiation

18620248A Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 15 No 10, 26 May 89 pp 21-24

[Article by I. A. Begishev, A. A. Gulamov, Ye. A. Yerofeyev, Sh. R. Kamalov, T. Usmanov, and A. D. Khadzhayev, Institute of Electronics imeni U. A. Aripov, UzSSR Academy of Sciences, Tashkent]

[Abstract] High-power pulses of tunable ultraviolet radiation were generated in an experiment with a 2-channel wide-aperture Nd-P glass laser. Radiation from the first channel was converted by a 90 percent efficient KDP frequency-doubler crystal (50x50x30 mm^3) into its second harmonic, for pumping a single-pass traveling-wave optical parametric oscillator on two KDP crystals (40 mm and 60 mm long respectively). Radiation from the second channel was converted in two stages, by a 90 percent efficient KDP crystal (50x50x30 mm^3) and then a 92 percent efficient one (50x50x10 mm^3), into its fourth harmonic. The fundamental radiation and its fourth harmonic were then combined in an ADP mixer crystal (50x50x10 mm^3) operating at room temperature. Also radiation from the optical parametric oscillator was fed into the mixer, by means of mirrors and a polarizing prism. Radiation pulses from the two channels were superposed in time by means of two mirrors forming a delay line. The resultant radiation was spatially resolved, by means of a dispersing LiF-prism, into its frequency components with the 215 nm short-wave edge. Pulses with a power up to 60 MW/cm^2 were thus generated. The efficiency did not exceed 20 percent, however, owing to dissimilarity of oscillator radiation and fourth-harmonic radiation characteristics as well as to deficiency of the infrared component in the oscillator radiation most efficiently interacting with fourth-harmonic radiation during mixing. Figures 2; references 4: 3 Russian, 1 Western.

UDC 621.373.826

Wavefront Correction in 'Interferometer-Nonlinear Medium' System

18620234A Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 3, Mar 89 pp 409-411

[Article by A. N. Bobrovskiy, Yu. P. Zagryazhskiy, Ye. B. Levchenko, and G. D. Mylnikov, Institute of Atomic Energy imeni I. V. Kurchatov, Moscow]

[Abstract] A scheme for correcting the wavefront of a pulsed laser beam is proposed, a Mach-Zehnder interferometer followed by a nonlinear medium. This scheme is simpler than schemes with phase conjugation or adaptive optics and ensures full correction of aberrations. The part of the laser beam which has been diverted by the first splitter plate from its main path to the upper interferometer arm is "cleaned" as it passes through a lens-diaphragm-lens filter between the two plane mirrors, whereupon the second mirror returns it to the second splitter plate and the latter combines it with the remainder of the laser beam for subsequent passage through the nonlinear medium. The feasibility of such a correction scheme with control of phase nonuniformity, demonstrated theoretically on the basis of Fresnel integrals, has been demonstrated experimentally with a TEA CO_2-laser and low-pressure NH_3-cell as a cubically nonlinear medium. The laser was tuned to the 1OR(14) line only 0.05 cm^{-1} away from the line of aR(1,1) transition in a NH_3 molecule and emitted a beam 2 cm in diameter in pulses of 0.001 ms duration and 4 J energy. Half the laser beam aperture was covered by a plane-parallel CaF_2-plate with a 0.50 transmission coefficient, the phase shift being varied either by rotating the plate or by varying the NH_3 pressure. Figures 2; references 7: 4 Russian, 3 Western (all in Russian translation).

UDC 621.373.826.038.825.2

Power Laser With Gd-Sc-Al:(Cr,Nd) Garnet as Active Medium and With Self-Q-Switching

18620234B Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 3, Mar 89 pp 474-477

[Article by A. A. Danilov, Ye. V. Zharikov, A. I. Zagumenniy, G. B. Lut-ts, M. Yu. Nikolskiy, V. B. Tsvetkov, and A. I. Shcherbakov, Institute of General Physics, USSR Academy of Sciences, Moscow]

[Abstract] A new solid-state power laser has been developed, namely a Gd-Sc-Al garnet doped with Cr^{3+} and Nd^{3+} ions in equal concentrations of 2 multiplied by 10^{20} cm^{-3}. Its operation at high average and peak power levels is made possible by transition of some Cr ions from trivalent into tetravalent ones with attendant formation of phototropic centers which absorb Nd-wavelength radiation so that the active medium is simultaneously lasing and Q-switching. Several such lasers were built and tested, cylindrical garnets with approximately 19 pct phototropic absorption and others without it being each placed inside a K-104 quantron with an INP-5/60 flash lamp as source of pulsed pumping radiation. The cavity for each garnet was formed by two dielectric mirrors, a spherical high-reflection coefficient. The lasers were pumped with pulses of 0.2 ms or 0.8 ms duration at repetition rates of 100 Hz or 20 Hz respectively. The maximum average output power of "clean" lasers pumped at a 100 Hz pulse repetition rate was 52 W at an efficiency of 2.6 pct, the emission threshold being 800 V pump power. The maximum average output power of "phototropic" lasers pumped at a 100 Hz pulse

repetition rate was 44 W at an efficiency of 2.2 pct, the emission threshold being 1100 W pump power. Pumping at a 20 Hz pulse repetition rate was done without and with compensation of the spherical component of the thermooptic lens. An average power of 100 W at an efficiency of 3.3 pct was attained without compensation. An average power of only 90 W at an efficiency of 2.8 pct was attained with compensation, with the spherical high-reflectance mirror replaced by one with a 1.0 m radium, but the mean-angular radiation intensity reaching 2 MW/sr and the peak-angular radiation intensity reaching 10 GW/sr. Figures 5; references 5: Russian.

UDC 621.373.826:533.9

Numerical Calculation of Characteristics of Recombinational Pumping in Low-Temperature Plasma

18620234C Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 3, Mar 89 pp 538-545

[Article by A. V. Borovskiy, V. V. Korobkin, L. Ya. Polonskiy, L. N. Pyatnitskiy, and M. I. Uvaliyev, Institute of General Physics, USSR Academy of Sciences, Moscow]

[Abstract] Recombinational pumping of multiple-charge ions in a low-temperature plasma is considered on the basis of the multilevel impact-radiative H-ion relaxation model with z larger than 3, ignoring possible gain saturation in a strong light field. The gain and the coefficient of nonresonant absorption in a nonequilibrium plasma, also the degree of ionization and the recombination coefficient as well as the coefficient of energy transfer to free electrons, are calculated by numerical methods as functions of electron concentration, electron temperature, and z. Into account are taken the rates of radiative and collisional transitions, also the populations of levels and the effective line width for gain calculations. The various approximations used for this numerical evaluation are validated by a comparison and reconciliation with results obtained by analytical methods. Figures 6; tables 4; references 23: 17 Russian, 6 Western (2 in Russian translation).

UDC 621.43:127.124

Optical Breakdown on Aerosol in Gases Under Elevated Pressure

18620234D Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 3, Mar 89 pp 558-561

[Article by S. V. Selishchev, A. L. Smirnov, G.R. Toker, and A. A. Uglov, Institute of Metallurgy imeni A. A. Baykov, USSR Academy of Sciences, Moscow]

[Abstract] An experimental study of optical breakdown on aerosol in N_2 and in Ar under pressures up to 50 atm was made, with holographic interferometry used for tracking initiation and subsequent development stages of such a breakdown. Aerosol was produced from a solid Ti or Zr target by its vaporization inside a high-pressure chamber with radiation pulses of 1.4 ms duration and 20-60 J energy from a Nd-laser operating at the 1,060 nm wavelength, its beam being focused by a lens on a surface spot 4 mm in diameter, and subsequent condensation of Ti or Zr vapor inside that gas chamber. Holographic interferometry with a probing beam of a ruby laser synchronized with the Nd-laser has identified the various stages of optical breakdown, volatilization of small individual particles during the 0.050 ms long initial period being followed by formation and growth of microclouds during the next 0.100 ms long period. During the subsequent 1.35 ms long period till the end of a vaporizing Nd-laser pulse the concentration of volatilized atoms increases and eventually exceeds the concentration of electrons, the refractive index along the breakdown axis then changing appreciably and the probing laser beam losing its coherence. Relaxation of breakdown begins after the end of a Nd-laser pulse and continues for 1-2 s. Figures 2; references 5: Russian.

UDC 621.373.826

Optimization of Conditions for Four-Wave Mixing of Continuous-Wave Radiation in Absorbing Medium

18620234E Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 3, Mar 89 pp 586-589

[Article by S. I. Klimentyev, V. V. Kononov, V. I. Kuprenyuk, and V. V. Sergeyev]

[Abstract] Four-wave mixing of continuous-wave radiation in an absorbing fluid is considered one of the transparent windows containing the fluid in the classical scheme with counterpropagating pump waves having been replaced by an adequately cooled plane mirror for better heat dissipation so as to ensure optimum coupling of the signal wave and the reflected wave. The relations between parameters characterizing the radiation, the absorbing fluid, and the cell structure are established by analysis and solution of the problem of steady-state heat conduction in a layer of fluid with internal heat sources, assuming that their distribution over the volume is determined simply by the interference of radiation beams with plane wavefronts and uniform radial intensity profiles. The feasibility of such a four-wave mixing scheme for recording thin dynamic holograms in a fluid is demonstrated on the basis of the diffraction theory for thin gratings. It has been demonstrated experimentally with a continuous-wave CO_2-laser as radiation source and an interaction cell containing toluene, the strong thermal lens forming in the entrance KCl-window upon incidence of the reference beam having been compensated so that a plane rather than divergent reflected wave was meeting the signal wave. The authors thank V. Ye. Sherstobitov and A. A. Betin for helpful discussions. Figures 2; references 5: 4 Russian, 1 Western (in Russian translation).

UDC 535.2+535.36

Stimulated Brillouin-Mandelshtam Scattering of Single-Mode and Weakly Nonuniform Light Beams

18620234F Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 3, Mar 89 pp 589-592

[Article by V. G. Brovkovich and B. N. Tyushkevich, Institute of Electronics, BSSR Academy of Sciences, Minsk]

[Abstract] An experimental study of stimulated Brillouin-Mandelshtam scattering of light beams was made which has revealed that a single-mode laser beam becomes transformed into a Stokes-radiation beam with a different intensity distribution and a smaller divergence than those of a Gaussian one, a weakly nonuniform single-mode laser beam with threshold or up to five times higher power being transformed into a single-mode beam with a narrower radiation pattern. The apparatus included a ruby laser emitting monopulses of 694 nm radiation, with an intracavity diaphragm and with passive Q-switching, followed by an optical rectifier consisting of a polarizer and a Faraday cell with a higher than 0.80 nonreciprocity coefficient, and an acetone cell. Radiation energy was measured with two calorimeters. The radial intensity profiles of the laser beam and of attenuated Stokes radiation were recorded on photographic film, after each had been made by a set of mirrors to travel an optical path of the same length. A theoretical analysis confirms the feasibility of wavefront transformation by this mechanism. Figures 2; references 8: Russian.

UDC 621.373.826.038.824

New Dyes for Passive Mode Locking in Nd^{3+}-Lasers

18620234G Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 3, Mar 89 pp 615-616

[Article by V. G. Balenko, O. L. Kaliya, A. N. Kirkin, Ye. A. Lukyanets, V. M. Mizin, M. B. Popov, N. V. Teplyakova, L. G. Tomilova, and Ye. V. Chernykh, Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Moscow]

[Abstract] Three dyes (Nos. 1088, 1089, 1090) belonging in the phthalocyanine group have been synthesized for passive mode locking in Nd^{3+}-lasers, these dyes being more stable than dyes of the polymethine group. All three with o-dichloro-benzene as solvent were tested with a YAG:Nd^{3+}-laser operating at the 1,060 nm wavelength. A cylindrical YAG rod 120 mm long and 8 mm in diameter was placed inside a flat cavity between two mirrors on a supporting wedge each, their reflection coefficients for 1,060 nm radiation being 0.99 and 0.30 respectively. A cell containing a 1-3 mm thick layer of dye solution was placed inside the cavity for mode locking. With any of these dyes in the cavity, the laser emitted 3-5 successive pulses of up to 50 mJ energy and not longer than 100 ps duration. The dye solutions, with an initial transmission coefficient of 0.30, were also tested for thermal stability at 100 deg C and found to retain it with a not larger than 20 pct decrease of optical density for 60 min (No. 1088), 120 min (No. 1089), and 8 h (No. 1090) respectively. Tables 1; references 1: Western.

UDC 621.315.592

New Possibilities for Radiation Conversion in a Membrane Optical Bistable Element

18620182A Minsk VESTSI AKADEMII NAUK BELORUSSKOY SSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 1, Jan-Feb 89 pp 48-51

[Article by A. L. Velikovich, G. P. Golubev, V. P. Golubchenko, A. E. Cartavtsev, and D. G. Luchinskiy]

[Abstract] This article reports the observation of self-oscillations in a membrane optical bistable element as well as modulation of helium neon laser radiation by the control beam from an argon laser by means of such an element. The experimental setup for this study was as follows: the argon laser radiation was focused onto a spot of approximately 20 mcm in diameter on the semiconductor membrane surface. The relation between the transmitted radiation and the impacting radiation was recorded by a Watanabe X-Y recorder or a Tektronix 7623A oscilloscope. The membranes were fabricated from ε-GaSe monocrystalline film approximately 1 mcm thick with a coefficient of thermal expansion 1.5 times 10^{-5} K^{-1}. In this configuration the natural crystal faces and the air gap between the mirror and the crystal formed a system of coupled Fabry-Perot cavities. This setup was used to produce oscilloscope traces demonstrating the modulation of the helium neon laser radiation transmitted through the specimen by the radiation from the argon laser. Estimates of the critical current suggest that a substantial nonlinear response of the element to thermal loading occurs as early as the 10 mW point. The optical bistability parameters obtained here suggest that the bistable membrane element may be useful for experimental modeling of purely optical logic circuits in addition to the popular ZnS and ZnSe interferential films used for these purposes.

Spectra of Hadrons, Muons, and Neutrinos in Atmosphere as Solution to Forward Problem

18620241A Moscow YADERNAYA FIZIKA in Russian Vol 50 No 1 (7), Jul 89 pp 142-156

[Article by A. V. Butkevich and I. M. Zheleznykh, Institute of Nuclear Research, USSR Academy of Sciences, and L. G. Dedenko, Moscow State University]

[Abstract] The energy spectra and the angular distributions of hadrons (nucleons, mesons) and leptons (muons, neutrinos) produced in the atmosphere upon interaction of particles in primary cosmic rays and atomic nuclei in air are calculated, the energy spectra being the solution to integro-differential equations of transport for the respective particles. The system of these equations is, after conversion to one of equivalent integral equations, solved by a matrix method which involves successive iterations for the sum of generations of particles. With the parameters of nuclear fission, the cross-sections for interaction of nuclei and for nucleon-meson interaction, and the inclusive spectra of secondary particles known form available data, this forward problem is solved for secondary particles covering the $1\text{-}10^5$ GeV energy range with the spectrum of primary cosmic radiation as initial and boundary condition. Numerical evaluation of the differential electron neutrino, muon neutrino, muon, and hadron spectra at sea level reveals their dependence on the zenith angle, the neutrino-to-antineutrino for both kinds of neutrino also depending on that angle. The agreement with available experimental data is close within 8-15 pct so that no additional normalization to the measured spectrum of any kind of particle is necessary. The method can be adapted for solution of an inverse problem such as calculation of the parameters of primary cosmic radiation. Figures 7; tables 4; references 49: 12 Russian, 37 Western.

New Corrections for Hyperfine Splitting in Muonium and in Hydrogen

18620235A Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 50 No 1, 10 Jul 89 pp 3-6

[Article by S. G. Karshenboym, V. A. Shelyuto, and M. I. Eydes, All-Union Scientific Research Institute of Metrology imeni D. I. Mendeleyev]

[Abstract] Radiativeα^2(Z x α)E_F-order corrections to hyperfine splitting of two-photon emission are obtained which represent polarization inserts into outer photons, considering that the matrix elements of six gauge-invariant graph sets yield all the corrections of this order. The three of them for polarization inserts correspond to contributions of the latter to E_{1P}, E_{2P}, and $E_{RP}^{(2)}$ respectively. They are calculated analytically by integrating with respect to momentum and velocity of an exchange photon. They are evaluated numerically for muonium and hydrogen. The authors thank V. G. Ivanov, G. A. Isaakyan, and P. I. Okon for assisting in numerical computations. Figures 1; references 15: 4 Russian, 11 Western (1 in Russian translation).

Neutrino Stalling in Material Medium

18620235B Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 50 No 1, 10 Jul 89 pp 10-12

[Article by D. A. Kirzhnits, V. V. Losyakov, and V. A. Chechin, Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences]

[Abstract] It is demonstrated theoretically that the energy loss per unit time by a two-component neutrino during interaction with an electron in a material medium cannot exceed the natural "collisional" limit based on the model of a free low-density electron gas, which precludes anomalous neutrino stalling, just as the energy loss per unit time by an electron cannot exceed this limit owning to the Fermi density effect. A neutrino is assumed to be massless and the medium is assumed to be a cold nonrelativistic amorphous one, neutrino-electron interaction being expressed in the standard four-fermion form. Nonconservation of parity adds a significant axial response of the medium to its vector response and thus makes the energy loss by a neutrino dependent on three characteristic medium parameters $R_{1,2}{}^a$ R_3 (energy loss by an electron depending on only two parameters $R_{1,2}{}^V$), according to the second-order perturbation theory with explicit covariant parametrization of the Green function for electron currents. References 3: Russian.

Quantization and Charge of Soliton in Peierls Model

18620240A Moscow ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 96 No 1 (7), Jul 89 pp 229-236

[Article by S. A. Brazovskiy and S. I. Matveyebko, Institute of Theoretical Physics imeni L. D. Landau, USSR Academy of Sciences]

[Abstract] Solitons in a mixed-state Peierls dielectric are quantized quasi-classically by application of Hamilton's principal to the Lagrangian of the system and inclusion in the lowest-order quasi-classical series expansion also quantum fluctuations in the vicinity of a soliton solution to the Schroedinger equation. The electric current and the charge (quotient of electric current by excitation rate equal to soliton velocity) are calculated analytically, taking into account spontaneous deformation caused by the Peierls effect and constant deformation due to the molecular structure. Both nondegenerate and degenerate groundstates are considered, both electric current and charge of a polaron and of a bipolaron then being calculated for a pure Peierls dielectric without structure-related deformation. One extreme case is a pair of unbound kinks. In the other extreme case injection of one electron into a local level knocks out two electrons

from the valence band without fully compensating the electric charge of a particle. References 13: 6 Russian, 7 Western.

Soliton States With 1/2-Spin in Crystalline Polyacetylene

18620240B Moscow ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 96 No 1 (7), Jul 89 pp 214-223

[Article by L. A. Kosykh, G. V. Lepyanin, and A. N. Chuvyrov, Department of Physics and Mathematics with Computer Center, USSR Academy of Sciences, Bashkir branch]

[Abstract] An experimental study of topological and dynamical solitons with 1/2-spin in monoclinic, hexagonal, and orthorhombic crystals was made, for a determination of their charge and velocity on the basis of EPR spectra. Measurements were made with an RE 1306 spectrometer at the 3 cm wavelength and with an RE 1308 spectrometer at the 8 mm wavelength, on intrinsic polyacetylene crystals and on such crystals weakly doped with iodine. The activation energy for spin states was estimated on the basis of temperature measurements during cooling down to 4.2 K, which also yielded the temperature dependence of magnetic susceptibility, spin states density, and EPR-line width. A theoretical analysis of the data reveals a correlation between number of spin states and number of charge carriers in weakly doped polyacetylene crystals, a correlation between electrical conductivity and magnetic properties of polyacetylene crystals, their electrical conductivity also depending on the dopant concentration, and a dependence of the EPR-line width as well as of the soliton velocity on the crystal structure including crystal system and degree of defectiveness. Crystals were not doped beyond the 10-12 pct level, this level corresponding to the stability limit of the transisomer. The authors thank I. V. Ovchinnikov and I. A. Garifulin for assisting in measurements, and R. M. Galimov for helpful discussion in some results. Figures 8; references 16: 5 Russian 11 Western (1 in Russian translation).

Yields of Delayed-Neutron Groups in ^{229}Th Fission by Thermal Neutrons

18620215A Moscow YADERNAYA FIZIKA in Russian Vol 49 No 6, Jun 89 pp 1551-1555

[Article by A. N. Gudkov, A. B. Koldobskiy, S. V. Krivasheyev, N. A. Lebedev, and V. A. Pchelin, Moscow Institute of Engineering Physics]

[Abstract] In an experiment with low-energy ^{229}Th fission by thermal neutrons were for the first time measured the yields of five delayed-neutron groups, these yields being highly informative about the final stage of the fission process and about the composition as well as the charge distribution of its products including even-odd effects at low excitation levels and their dependence on Z_F^2/A. The measurements were made in the Institute's research reactor. The readings obtained in 100 fission events are, following a statistical analysis, compared with available reference data on fission of ^{235}U and ^{229}Th. Figures 1; tables 4; references 20: 5 Russian, 15 Western.

Ionization Accompanying Internal Conversion. Contribution of Deep Shells

18620215B Moscow YADERNAYA FIZIKA in Russian Vol 49 No 6, Jun 89 pp 1607-1612

[Article by Ye.G. Drukarev and M.B. Trzhaskovskaya, Leningrad Institute of Nuclear Physics, USSR Academy of Sciences]

[Abstract] Ionization of electron shells which accompanies internal conversions in atoms and yields 4-100 keV electrons is analyzed for applicability to measurement of the neutrino mass, into account being taken the contribution of deep shells. General expressions for the total probability of ionization and for the transferred energy, its mean value and dispersion, are derived from the probability of transition of an ion from chi-state to psi-state, using the Dirac-Fock wave function and the rule of sums as well as the spectrum of energy losses in an inelastic process. Numerical results have been obtained on this basis pertaining to a $^{169}Tm_{69}$ atom with secondary electrons not exceeding either 1.4 keV or 1.7 keV, shells deeper than the 3d-shell having been necessarily included in the latter case. The authors thank V.A. Lyubimov and V.Z. Nozik for discussing practical implications, I.M. Band for valuable discussions, and L.Kh. Valyamova for formatting the manuscript. Figures 2; tables 2; references 7: Russian.

Induced Interaction of Neutrinos and Magnetic Field in Neutronic Medium

18620215C Moscow YADERNAYA FIZIKA in Russian Vol 49 No 6, Jun 89 pp 1657-1664

[Article by L. V. Leinson and V. N. Orayevskiy, Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation]

[Abstract] Interaction of neutrinos and a magnetic field in a neutronic medium with negligible concentrations of free electrons and nuclei is analyzed, considering that paramagnetism of neutrons induces a magnetic moment in neutrinos and that interaction of neutrinos with collective vibrations of the medium in the form of a spin density wave makes the effective electromagnetic vertex of neutrinos frequency-dependent with resonance at the frequency of the spin density wave. This electromagnetic vertex is calculated by averaging the microscopic-scale neutrino-neutron interactions within a physically infinitesimal volume of the medium. Calculations based on the Hamiltonian of four-fermion neutrino-neutron point interaction, assuming a neutrino energy much smaller

than the Z-boson mass, yield the corresponding dispersion equation and the cross-section for scattering of neutrinos by spin density fluctuations. References 13: 12 Russian, 1 Western.

Summation Over Topological Classes of Gauge Fields in Lattice Gauge Theories

18620215D Moscow YADERNAYA FIZIKA in Russian Vol 49 No 6, Jun 89 pp 1799-1806

[Article by D.R. Lebedev, M.I. Polikarpov, and A.A. Roslyy, Institute of Theoretical and Experimental Physics, State Committee on Use of Atomic Energy]

[Abstract] Including summation over topological classes of fields on a four-dimensional torus for calculation of quantum means in lattice gauge theories is considered, this being possible on the basis of the relation between boundary conditions on the torus according to t'Hooft and the topological charge. Lattice equations of motion are proposed which have all solutions to the lattice analogs of self-duality and antiself-duality equations for any length of a lattice bar. All solutions satisfy the Bianchi identity in the continuous limit, which can be proved graphically as well as analytically with the aid of Hermitian-conjugates, so that summation over different topological classes of fields reduces to summation over different boundary conditions on the torus. The authors thank O.V. Ogiyevetskiy and Yu.A. Simonov for interest and valuable comments. Figures 1; tables 1; references 8: 1 Russian, 7 Western (1 in Russian translation).

Precision Measurement of Masses of Elementary Particles in Storage Rings With Polarized Beams

18620226A Moscow USPEKHI FIZICHESKIKH NAUK in Russian Vol 158 No 2, Jun 89 pp 314-326

[Article by A. N. Skrinskiy and Yu. M. Shatunov, Institute of Nuclear Physics, Siberian Department, USSR Academy of Sciences, Novosibirsk]

[Abstract] The masses of particles produced in electron-positron collisions were measured by the L. M. Kurtadze high-precision absolute method of measuring the energy of particle beams in storage rings. Calibration was based on the correspondence between energy and frequency of spin precession of a relativistic electron moving at a constant speed in a transverse magnetic field, this correspondence being disturbed only by longitudinal magnetic fields which a particle may encounter along its orbit. Resonant depolarization occurring during measurement is described, to explain the action of depolarizing devices such as a traveling wave in a scheme with colliding particle beams. Radiative polarization of electrons and positrons is analyzed, to confirm the effectiveness of this mechanism in producing depolarizable polarized particle beams with sufficiently high energy in storage rings. Following precise calibration and stabilization of particle energy in the storage rings, the masses of five mesons (phi, omega, K-positive, K-negative, K-neutral) were measured in the VEPP-2M Vertical Electron-Positron-Beam accelerator and the masses of five other mesons (psi, psi', Upsilon-resonance, Upsilon'-resonance, Upsilon"-resonance) were measured in the VEPP-4 Vertical Electron-Positron-Beam accelerator at the Institute of Nuclear Physics in Novosibirsk. The data are analyzed statistically, taking into account six probable sources of systematic errors: 1) finite bandwidth of depolarizer, 2) location of collision space relative to accelerator cavities and detector, 3) electric field in storage ring, 4) chromaticity of magnetic optics, 5) effects of collision, 6) effect of spin resonances. Figures 7; tables 1; references 22: 14 Russian, 8 Western.

UDC 533.9.01

Emission of Electromagnetic Waves by TE-Mode Solitons

18620227A Moscow FIZIKA PLAZMY in Russian Vol 15 No 6, Jun 89 pp 700-705

[Article by A. V. Kochetov, Institute of Applied Physics, USSR Academy of Sciences]

[Abstract] Emission of electromagnetic waves by TE-mode solitons egressing from a dense plasma to its boundary with a linear dielectric is analyzed, assuming that nonlinearity of such a plasma derives from any mechanism which adds to the constant permittivity of a quiescent plasma another term proportional to the electric field squared. The process is treated as a quasi-monochromatic one with boundary conditions of zero electric field at minus infinity and an electric field divergence proportional to the electric field at the origin, considering that solitons represent the asymptotically final stage of field evolution (which has been demonstrated by the method of inverse scattering theory). The corresponding nonlinear Schroedinger, obtained for waves slower than high-frequency waves by averaging over the period of the high-frequency field, has soliton solutions. These contain two free parameters, amplitude and velocity, the quotient of which determines the efficiency of energy transfer from soliton to electromagnetic radiation. The equation for this efficiency is converted in accordance with the approximating Crank-Nicholson difference scheme for computer-aided numerical solution by the difference factorization method, for those two aforementioned boundary conditions. Both transmission and reflection coefficients at the plasma-dielectric boundary are then calculated as functions of time, to demonstrate the quasi-periodicity of the process and that transirradiation of a thick layer of a supercritical plasma is possible on the premise that TE-mode solitons can be excited in it by an incident wave and can propagate through it without dispersion. The author thanks A. G. Litvak for helping to formulate the problem and V. A. Mironov for participating in the discussions. Figures 3; references 13: 11 Russian, 2 Western.

UDC 537.52+66.054.36

Desorption of Deuterium From TiD_2 in Pulsed Electric Fields

18620229A Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 34 No 6, Jun 89 pp 892-894

[Article by A. M. Avilov, I. A.Borshovskiy, V. D. Volovik, and S. I. Ivanov, Kharkov University imeni A. M. Gorkiy]

[Abstract] An experimental study of deuterium desorption from TiD_2 in a pulsed electric field was made, such an electric field being produced by oscillations of a Ti pendulum-electrode in the gap between the two Ti plates of a vacuum capacitor. Measurements were made inside a vacuum chamber, an optical spectrometer being used for extraction of D_α-lines from the Balmer series. Ejection of Ti, TiD_2, D_2, and absorbed other gases (H_2) caused a rise of pressure in the chamber. Desorption of D_2 as well as that of other gases was estimated on the basis of pressure measurements, the rate of natural gas suction into the chamber being subtracted from readings of the change in the degassing rate in the electric field. The voltage dependence of this difference and of the ratio of D_α flash frequency to pendulum oscillation frequency indicates that desorption of deuterium and hydrogen from a TiD_2 surface is much more intense and becomes still more so with increasing voltage than their desorption from a pure Ti surface. According to earlier estimates based on 25 KeV electrons in the plasma adjacent to the electrode surface, desorption of deuterium follows photoabsorption by the electrode material of bremsstrahlung emitted by such electrons. Figures 2; reference 3: Russian.

Motion of Davydov Soliton in Periodic Potential

18620247A Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 59 No 5, May 89 pp 1-5

[Article by A. A. Vakhnenko and A. A. Yeremko, Institute of Theoretical Physics, UkSSR Academy of Sciences, Kiev]

[Abstract] Motion of a Davydov electric soliton in a periodic potential of a molecular chain containing inhomogeneities is described theoretically by simulation of an experiment which involves recording an electric current in a material such as a high-temperature superconductor in the field of a traveling sound wave. The system of two differential equations describing this phenomenon is converted into a single integral equation for the center of gravity of such a soliton, in the adiabatic approximation, and the latter equation is then reduced to an algebraic one. Inasmuch as retarding forces are small, delays are assumed to be negligible. That equation is solved first for a soliton moving in a static periodic potential and for one moving with a sound wave, the latter shown to drag it along and to thus accelerate it by way of energy transfer. This theoretical model applies to a slow soliton and, obviously, not to one traveling faster than the sound wave. References 9: 6 Russian, 3 Western (1 in Russian translation).

Diffusivity of Solitons

18620210A Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 49 No 9, 10 May 89 pp 489-491

[Article by B. A. Ivanov and A. K. Kolezhuk, Institute of Metal Physics, UkSSR Academy of Sciences]

[Abstract] The possibility of soliton excitation in quasi-one-dimensional ordered media such as ferromagnetic and ferroelectric materials having been demonstrated by behavior of the central peak in the spectrum of magnetic susceptibility during inelastic scattering of neutrons, diffusion of a soliton upon its interaction with magnons is analyzed on the basis of Newton's second law with the gradient of the corresponding Hamilton-Routh function representing the force. Refinement of the exactly integrable sine-Gordon model and application of the perturbation theory to the Hamiltonian, assuming a low soliton velocity and a Gaussian random force with zero average over the thermostat of magnons, yield two diffusion coefficients. The conventional one, related to viscosity of a soliton in accordance with the Einstein equation and infinite in the case of exact integrability, becomes finite upon departure from this model. The other one represents randomization of the soliton coordinate owing to Brownian motion of a soliton during its propagation at constant velocity. The authors thank V. G. Baryakhtar, I. Ye. Dzyaloshinskiy, A. S. Kovalev for helpful discussions and Yu. N. Mitsay for collaboration. References 16: 5 Russian, 11 Western (1 in Russian translation).

UDC 539.16

Theory of Muonic EO-Conversion

18620212A Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 34 No 5, May 89

[Article by A. N. Lavrenov, Scientific Research Institute of Application Problems in Physics imeni A. N. Sevchenko, Belorussian University imeni V. I. Lenin, Minsk]

[Abstract] Nonradiative transition of a muon from 2p level to 2s level in heavy mesoatoms with attendant excitation and prompt fission of the nucleus is analyzed for the probability of muonic EO-conversion on the K-shell. This probability is estimated not by integrating the corresponding matrix element with respect to angular coordinates but by expanding the products of the two integrand radial muon wave functions by the radial coordinate into a Taylor series at the origin of that coordinate. Calculations for a muon with a kinetic energy of 1.5 MeV based on the model of surface and volume transition currents as well as on the Tassie model, in relativistic systems of units for surface and volume charge distributions, demonstrate that inclusion

of only four nuclear u-parameters will yield an estimate with an error not exceeding 10 pct. Consideration of only one parameter u_O is needed for estimating the probability of electronic EO-conversion on the K-shell with the same accuracy. Figures 3; references 13: 7 Russian, 6 Western (1 in Russian translation).

UDC 07;09;12

Source of Picosecond Pulses for High-Speed Soliton Fiber-Optic Data Transmission System

18620211A Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 15 No 9, 12 May 89 pp 25-29

[Article by V. Yu. Petrunkin, V. M. Sysuyev, A. S. Shcherbakov, D. Z. Garbuzov, Yu. V. Ilin, A. V. Ovchinnikov, and I. S. Tarasov, Leningrad Polytechnic Institute imeni M. I. Kalinin]

[Abstract] A source of a continuous sequence of optical (1,320 nm) picosecond pulses for high-speed fiber-optic data transmission systems is proposed, this source including an InGaAsP/InP double-heterojunction laser with an ultrathin active region which emits powerful single-mode radiation. The longitudinal laser modes are locked actively to an external cavity by means of periodic Q-switching, an alternating current whose frequency is equal to the spectral difference between the longitudinal laser modes being added to the injection current. Laser and cavity are optically matched, power supply and laser monitor are electrically matched, and the laser is thermally stabilized by means of a Peltier cell with control. The cavity contains a microobjective lens with a 0.9 numerical aperture and a plane reflective diffraction grating with 300 lines/mm, the latter mounted so that the first diffraction order focuses directly onto the active region of the laser diode. The power supply receives a constant current from a current source and a high-frequency signal from a microwave oscillator. The electrical parameters of the laser are monitored on a stroboscopic high-frequency oscillograph and a low-frequency one. The duration of optical pulses is measured by the auto-correlation method, a part of the laser radiation being diverted wither to a scanning Michelson interferometer or to a frequency-doubling nonlinear crystal. The source can generate optical pulses of 10-20 ps duration at a repetition rate of 1 GHz, the power per pulse being at least 0.5 W. This source can be adapted for generating optical (1,300-1,600 nm) pulses of shorter than 10 ps duration at repetition rates of 10-20 GHz, to be used in soliton fiber-optic data transmission systems. Figures 2; references 9: 8 Russian, 1 Western.

Scale Conversions of Nonstationary Images by Photon Echo Signals

18620207B Moscow ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 95 No 5, May 89 pp 1587-1597

[Article by S. M. Zakharov, Moscow Institute of Engineering Physics and E. A. Manykin, Institute of Atomic Energy imeni I. V. Kurchatov]

[Abstract] The processes of recording and reconstructing nonstationary optical images by photon echo signals are analyzed, starting with interaction of coherent light pulses and a resonant medium. This interaction and subsequently propagation of a light beam with a spherical wavefront from a plane slide to a hologram are described, in the quasi-optical approximation, on the basis of the parabolic equation of diffraction and the Green's function apparatus. Signals of primary photon echo are shown to form nonstationary images mirror-reversed in time and scaled in space. Scale conversions are then demonstrated in recording of images by signals of stimulated (with three pulses) photon echo and in reconstruction of images by signals of modified (in three-level resonant medium) stimulated photon echo. References 41: 19 Russian, 22 Western.

The Radiative Decays of Leptons in the Standard Supersymmetry Model

18620203A Moscow YADERNAYA FIZIKA in Russian Vol 49 No 4, Apr 89 pp 1163-1173

[Article by G. G. Volkov, G. G. Devidze, A. G. Liparteliani, and F. G. Trebuchava]

[Abstract] This study represents a further attempt to estimate the role of superpartners (scalar leptons, Higgsinos, photinos, etc.) in the lepton radiative decay processes within the framework of the standard supersymmetry model. The most general form of the form-factors of the one-loop vertex function is given and the widths of these radiative decays are calculated. The scalar lepton masses are also estimated for maximum mixing angles in the scalar sector based on the modern upper bound of the relative decay probability of the decay event μ to γ.

Scattering of Atoms by a Quasiresonant Standing Lightwave Field

18620185A Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 34 No 3, Mar 89 pp 352-360

[Article by A. A. Makarov and B. D. Pavlik]

[Abstract] This article examines the important case where frequency detuning of a standing light wave field relative to the atomic transition frequency and the Rabi frequency characterizing the magnitude of dipole interaction of an atom with the wave field significantly exceeds the quantity kv characterizing the Doppler frequency shift for an atom traveling at a velocity v along the standing lightwave with a wave number k. The study then carries out analytical calculations of the eigenvalue and eigenvectors of the quasienergy states of the atom and employs a computer for numerical calculation of the dipole transition probabilities between the initial and any random final quasienergy states. An optimum relation is found between the amplitude and detuning of the standing wave field where the most efficient momentum exchange between the atom and the field occurs. This

model can be used successfully on relaxation systems, thereby substantially symplifying the analysis and allowing a simple physical interpretation of the results.

The Soliton Dynamical Structural Factor of a Classical Easy-Axis Single-Dimensional Antiferromagnet

18620185B Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 34 No 3, Mar 89 pp 429-434

[Article by A. K. Kolezhuk]

[Abstract] This study investigates the contribution of nonlinear excitations in the form of 180° domain boundaries and localized solitons in the dynamical structural factor of a classical one-dimensional antiferromagnet with easy axis anisotropy. The study limits the analysis to neutron scattering by magnetic induction inhomogeneities. The study demonstrates that it is necessary to account for the contributions of the 180° domain boundaries as well as the small-amplitude localized solitons. Both these contributions produce the so-called central frequency peak with the first contribution significant near the spin flop-transition point only where it determines the integral peak intensity. The second contribution determines the peak width. The study also concludes that in analyzing the magnetic scattering of neutrons the kinks in antiferromagnets with easy axis anisotropy behave in the same manner as bions in ferromagnets. This is because the kinks in antiferromagnets are not topologic solitons in the vector field.

Effect of Electron-Electron Interaction on Phase Soliton Charge in the Peierls-Frohlich Model

18620178A Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 78 No 3, Mar 89 pp 335-344

[Article by A. V. Balataskiy and S. I. Matveenko]

[Abstract] This article calculates the phase soliton charge in the Peierls-Frohlich model accounting for electron-electron interaction. The study employs a field-theoretical formulation of the model in an external electromagnetic field and utilizes bosonization routines to reduce the theory to the sine-Gordon model. The study proposes a current definition that is more natural as in this case the current is determined in the standard manner as a response to the external field. The study also suggests that electron-electron interaction renormalizes the phase soliton charge in the Peierls model.

Autosolitons

18620179A Moscow USPEKHI FIZICHESKIKH NAUK in Russian Vol 57 No 2, Feb 89 pp 201-266

[Article by B. S. Kerner and V. V. Osipov]

[Abstract] This article examines autosolitons: localized stationary states in a variety of physical, chemical, and biological systems. Solitons are isolated waves generated in nonlinear, dispersive media and are similar to particles in many of their properties. This article carries out a detailed analysis of the physics of autosolitons in several types of systems based on semiconductor and gas plasmas, including thermal diffusion autosolitons in "positive" and "negative" thermal diffusion systems and the static, pulsating and traveling autosolitons in systems with a homogeneously-generated "fuel." Other aspects of autosolitons include static autosolitons, the stability and evolution of static autosolitons (KN- and KI-systems), peak static autosolitons as well as the pulsating and traveling autosolitons (KO systems) discussed above. A general theory of autosolitons is given together with general results which determine the primary parameters and properties of static, pulsating, and traveling autosolitons formed in a wide range of systems including chemical and biochemical reactions, nonequilibrium gases and superconductors, photoconductors and magnets, magnetic semiconductors, composite superconductors, active optical fiber links and many other systems.

Pulsed Excitation of Solitons in Easy Plane Ferromagnets

18620181B Leningrad FIZIKA TVERDOGO TELA in Russian Vol 31 No 2, Feb 89 pp 209-210

[Article by Yu. S. Kivshar and B. A. Malomed]

[Abstract] This study presents a consistent solution to the problem of pulsed excitation of solitons using a $CuRb_2Cl_2$-$2H_2O$ easy plane ferromagnetic specimen. The analysis considers the case of an external constant field oriented in the basis plane as well as an auxiliary pulsed field at an angle to the magnetic field. The study employs the spatial field distribution at the end of pulse action as the initial condition for an exact solution of the sine-Gordon equation to solve the primal scattering problem and to determine the so-called scattering data for the inverse scattering method. This approach is then used to account for the effect of dissipation, which is particularly important for magnetic systems on the threshold magnetic soliton excitation conditions. The study also suggests that at certain times the spin waves generated by the pulse field will decay, while in the area where the pulsed field is applied, stabilized magnetic solitons will appear and these will make a substantial contribution to the low-frequency absorption of light-plane ferromagnets.

UDC 621.372.8.029.7

Effect of Higher-Order Dispersions and Nonlinearities on Interaction of Femtosecond Solitons in Fiber-Optic Waveguides

18620244C Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 7, Jul 89 pp 1456-1459

[Article by Ye. M. Dianov, Z. S. Nikonova, and V. N. Serkin, Institute of General Physics, USSR Academy of Sciences, Moscow]

[Abstract] Interaction of femtosecond solitons in fiber-optic waveguides is analyzed for the effect of higher-order (up to third) dispersions and nonlinearities. The analysis is based on the nonlinear Schroedinger equation for the complex amplitude of the envelope of ultrashort-wave packets. Combination-frequency conversion is disregarded, inasmuch as a shift of the soliton frequency can be compensated by intensification of Raman scattering. Evolution and subsequent interaction of sech τ solitons is considered, numerical calculations having been made for such solitons of 100 fs duration in optical fibers up to 1 km long. The trajectories of pulse peaks, calculated with the absolute value of parameter β and the value of parameter γ both varied over the 0.01-0.1 range (β negative), indicate that data transmission by such solitons without destabilization of their waveform is feasible at a rate of 1 Tbit.km/s with a clocking pulse repetition interval of 1 ps. Both parameters may be equal to 0.02, but not larger, even for transmission over a 1 km long fiber-optic waveguide. Figures 3; references 12: 4 Russian, 8 Western.

UDC 621.373.826

Phase Control of Light Pulses by Means of Optical Feedback

18620221D Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 6, Jun 89 pp 1101-1103

[Article by M. A. Vorontsov and K. V. Shishakov, Moscow State University imeni M.V. Lomonosov]

[Abstract] Control of the spatial phase front by means of optical feedback for maximally efficient utilization of the laser beam energy in terms of minimum beam divulgence and optimum radiation intensity distribution over the focal spot is considered, in preference to wavefront control by phase conjugation or by means of adaptive optics in the case of high-power lasers. Optical feedback can be established by inserting a thin layer of a Kerr material into the medium of the output amplifier stage and diverting a small part of the laser output radiation with a low-reflectance mirror into an external cavity formed by two other mirrors. The performance of such a corrector is analyzed theoretically, assuming a local Kerr nonlinearity in the amplifier output stage and a negligible wave time delay in the feedback loop with the external cavity. Phase distortions in the main beam are described by linear combinations of eleven Zernicke polynomials with correspondingly eleven random coefficients, each having a normal distribution with zero mean value and the same dispersion. The corrector control is designed according to the algorithm of phase conjugation, compensation of aberration in the feedback loop being characterized by the Stroeli number. Figures 2; references 5: 3 Russian, 2 Western (1 in Russian translation).

UDC 621.373.826:778.38

Thermal Sensitization of Photographic Emulsion for Hologram Recording

18620221E Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 6, Jun 89 pp 1291-1293

[Article by V. A. Batanov, K. Yu. Kuzmin, I. A. Lesnov, S. V. Timofeyev, and V. B. Flerov, Institute of General Physics, USSR Academy of Sciences, Moscow]

[Abstract] An experiment involving thermal sensitization of photographic emulsion has demonstrated the feasibility of hologram recording with long-wave radiation. Recording was done first with an infrared beam from a pulsed TEA CO_2-laser, in pulses of 100 mJ energy at the 0.0106 mm wavelength, the laser beam being split by a plane-parallel GaAs plate into a reference beam and an object beam. Recording was also done with a submillimetric-wave beam from a pulsed NH_3-maser, in pulses of 2 mJ energy at either 0.090 mm or 0.152 mm wavelength depending on whether the maser was pumped with 9R(16)-line or 10P(32)-line radiation from a CO_2-laser. The pumping radiation was without additional focusing injected through a NaCl window into the active medium of the NH_3-maser, under a pressure of 10 mm Hg, and the maser output radiation was focused on photographic film by a spherical mirror. As the object was selected a plane grid of stainless steel wire 0.2 mm in diameter with a 1.0 mm mesh size, placed 6 cm away from an "LIT" FT-10 photographic film. The film was sensitized with flashes from an IFK-120V lamp, the latter being triggered 0.003 ms after the end of a recording pulse and producing a latent thermogram. Heat was measured with an RJ-7200 calorimeter. The angle between reference beam and object beam was 12 deg, corresponding to a 0.050 mm space period of the interference pattern on a hologram. After the film had been developed, fixed, and dried, a hologram was reconstructed with a light beam from a continuous-wave He-Ne laser and the image of the object then, together with the transmitted part of this laser beam, photographed on FOTO-64 photographic film. Figures 3; references 3: 1 Russian, 2 Western.

UDC 10;12

New Mode of Operation for Hyperboloidal Mass Spectrometer Containing Three-Dimensional Trap

18620211B Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 15 No 9, 12 May 89 pp 85-87

[Article by E. P. Sheretov, M. P. Safonov, B. I. Kolotilin, S. P. Ovchinnikov, V. S. Gurov, I. V. Veselkin, A. P. Borisovskiy, and V. I. Banin, Ryazan Institute of Radio Engineering]

[Abstract] A new mode of operation has been realized for a hyperboloidal mass spectrometer containing a three-dimensional trap, namely with the analyzer tuned to the second common stability zone. The field electrodes need to be shaped precisely so as to make the trajectories of charged particles describable by a system of linear second-order differential equations which reduces to a system of Mathieu equations when a harmonic voltage has been applied. There generally existing an infinite number of common stability zones with continuous boundaries, operation of such a mass spectrometer in a higher than first common stability zone was attempted for the Venera-Halley space program. Essential are a new design of the electrodes and correspondingly an appropriate new technology, the smallest dimension of the ring electrode being 32 mm and the distance between the outer electrodes being 32 mm. A meander-pulse voltage with a 240 V swing was applied across the outer electrodes, with a positive bias applied to the ring electrode, and the mass spectrum was scanned by varying the frequency of the signal from a microprocessor-controlled frequency synthesizer. Within the second positive common stability zone, confirming calculated estimates, the minimum resolution of the instrument for 28 a.m.u. was 160 at the 0.5 level, 220 near the lower edge and 325 near the upper edge. References 6: 5 Russian, 1 Western.

UDC 535.551

Franz-Keldysh Magnetooptic Effect in Field of Strong Bichromatic Light Wave

18620209A Leningrad FIZIKA TVERDOGO TELA in Russian Vol 31 No 5, May 89 pp 220-225

[Article by B. S. Monozon, Leningrad Institute of Shipbuilding, Leningrad]

[Abstract] Interband dipole one-photon absorption of a strong monochromatic light wave by a wideband semiconductor is analyzed, the semiconductor having been placed in the field of another strong monochromatic light wave with different amplitude and frequency but propagating in the same direction as well as in a uniform electric field and a uniform magnetic field both parallel to the two light waves. The semiconductor is assumed to have a wide forbidden band between an electron band and a hole band, both bands being parabolic and orbitally non-degenerate. The absorption power spectrum with even-photon and odd-photon peaks is calculated over the entire range of frequency mismatch between the two light waves within which the electric field shifts the peaks of odd-photon magnetic transitions toward shorter waves and diffuses them owing to the Franz-Keldysh effect. Into account are taken electron-hole Coulomb interaction and resulting formation of a diamagnetic exciton. First a strong electric field is considered, one stronger than the Coulomb field which almost completely ionizes the exciton states in semiconductors such as Ge, GaSb, InAs, InSb. Then a weak electric field is considered, one weaker than the Coulomb field which shifts the fundamental exciton peak toward longer waves owing to the quadratic Stark effect and widens somewhat more. Figures 1; references 15: 12 Russian, 3 Western.

Applicability of n-InSb Low-Inertia Detectors of Submillimetric-Wave Radiation at 77 K Temperature

18620247B Leningrad ZHURNAL TEKHNICHESKOY FIZIKIinRussianVol 59 No 5, May 89 pp 111-113ba

[Article by S. D. Ganichev, S. A. Yemelyanov, Ya. V. Teretyev, and I. D. Yaroshetskiy, Institute of Engineering Physics imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad]

[Abstract] An experimental study of n-InSb devices operating at 77 K temperature was made, for an evaluation of their performance as detectors of submillimetric-wave radiation pulses. They were tested with a tunable NH_3-maser emitting 0.09055 mm or 0.140 mm radiation and with a D_2O-maser emitting 0.385 mm radiation, both masers being optically pumped. The radiation intensity was varied up to 150 kW/cm^2 and the pulse duration was varied over the 40-100 ns range. The electron concentration in the InSb specimens was varied over a wide range about 9.3×10^{12} cm^{-2}. The data reveal a dependence of the photoconductivity on both the radiation intensity and the radiation wavelength. They also reveal a "fast"-response detector signal component and a "slow"-response one, the latter becoming significant as the radiation intensity exceeds a certain "threshold" about 60 kW/cm^2 for 0.09055 mm radiation and about 10 kW/cm^2 for 0.385 mm radiation. The intraband photoconductivity was found to increase linearly with increasing intensity of 0.09055 radiation and to decrease linearly with increasing intensity of 0.140 mm or 0.385 mm radiation, this decrease being however compensated by a lowering of the threshold for impact ionization. The concentration-dependent photoconductivity was found to increase exponentially with increasing intensity of any radiation, the "threshold" radiation intensity corresponding to equal relative changes of both photoconductivity components and such a detector ceasing to be reliable for higher radiation intensities. Figures 2; references 7: 6 Russian, 1 Western.

Tunable Pico- and Femto-Second Quasicontinuous Laser Radiation Sources Based on Fiber-Optic Converters

18620193A Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 4, Apr 89 pp 649-651

[Article by S. A. Akhmanov, D. N. Dovchenko, N. I. Zheludyev, and A. V. Simonov]

[Abstract] This article discusses the development and testing of a new family of completely solid-state tunable quasicontinuous picosecond and femtosecond laser sources. The fundamental laser design configurations include the RAC, RAC-n-RAM, and RAC-n-UP designs. The common element in these designs is a garnet CW-pumped acoustooptic mode locked and Q-switched laser producing 25 pulses per burst at half amplitude with a pulse packet repetition rate of up to 5 Hz and an average laser output power of 1.5 to 2 W at a pulse burst repetition rate of 1 kHz. The laser employs a two-circuit temperature stabilization design for the acoustooptic modulators as well as a cavity optical scheme that is stable with respect to the thermal lens in the active medium combined with high-efficiency mode locking and a modulation percentage exceeding 80 percent, thereby achieving good stability and reproducibility of the temporal, energy, and spatial parameters of the oscillator radiation. The article also discusses the various design configurations and possible applications of the RAC, RAC-n-RAM, and RAC-n-UP designs.

A Laser With YSGG:Cr, Nd and YSGG: Cr, Tm, Ho Crystal Active Elements Radiating at 1.06 and 2.088 mcm

18620193B Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 4, Apr 89 pp 673-675

[Article by A. N. Alpatyev, V. I. Konov, A. M. Prokhorov, A. S. Silenok, V. A. Smirnov, A. F. Umyskov, and I. A. Shcherbakov]

[Abstract] This article reports the development of an efficient free-running laser design producing coaxial radiation at 1.06 and 2.088 mcm by employing two different active elements in a single cavity. The first active element is a YSGG crystal containing chromium and neodymium and the second active element is a YSGG crystal containing chromium, thulium, and holmium impurities. Each active element was housed in its own elliptical quartz silver-coated illuminated 30 by 50 mm in diameter and excited by an INPZ/45 lamp. These lasers can find applications in medicine and surgery as a laser scalpel and for invasive operations, since radiation at these wavelengths has low losses in standard optical fibers. The lasers also supplement one another quite well since light at 2.088 mcm is easily absorbed by living tissue and can be used as a scalpel while light at 1.06 mcm has good coagulant action.

Efficient Second Harmonic Generation in a CO_2 Laser Using a GaSe Laser

18620193C Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 4, Apr 89 pp 757-763

[Article by G. B. Abdulayev, K. R. Allakhverdiyev, M. Ye. Karasyev, V. I. Konov, L. A. Kulevskiy, N. B. Mustarayev, P. P. Pashinin, A. M. Prokhorov, Yu. M. Starodumov, and N. I. Chapliyov]

[Abstract] This study is devoted to an analysis of second harmonic generation efficiency in a pulsed-periodic CO_2 laser employing a GaSe crystal and also compares the radiative parameters of second harmonic generation in GaSe and $ZnGeP_2$ crystals. A model 143 pulsed-periodic CO_2 laser was used in the experiments; the laser cavity was formed by an aluminum mirror with a radius of curvature of 5 m and a diffraction grating of 100 grooves per millimeter. The radiation was focused by NaCl lenses with a focal length of 15, 30, and 40 cm in order to obtain the second harmonic and to determine the damage thresholds of the test specimens. This configuration was used to measure the phase matching angles in GaSe at pump wavelengths of 9.3, 9.6, 10.3, and 10.6 mcm as well as the threshold power density of surface optical damage and the formation of a plasma flame operation the GaSe surface. The ultimate power density found for both specimens was 25 MW per cm^2 at 20 Hz. For GaSe at S equals 5.9 times 10^3 cm^2 this corresponds to a peak power of 147 kW. The tests indicate that a GaSe crystal can successfully compete with a $ZnGeP_2$ crystal as a material for frequency doubling of CO_2 laser radiation.

Switching Waves Between Stationary and Nonstationary States of Wide-Aperture Bistable Interferometers

18620193D Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 16 No 4, Apr 89 pp 785-788

[Article by N. N. Rozanov and G. V. Khodova]

[Abstract] This article examines the existence of switching waves between stationary, periodic and stochastic states in a nonlinear ring interferometer. These waves determine the spatial propagation of self-modulation and autostochasticity conditions. This study also notes that these switching waves are not identical to the order-chaos transition waves observed previously. The study identifies spatial-inhomogeneous field distributions that fluctuate in time and for which no noticeable advancement of the boundaries between different states exists. The switching waves are analyzed using a previously-reported equation and technique which describe radiation propagation in a nonlinear interferometer. Spatially-inhomogeneous distributions for this type of nonlinearity can be observed only by employing spatial filtering. The article provides profiles of switching waves from stationary to four-cycle conditions and from stationary to stochastic conditions after 200 and 100 interferometer passes. The results suggest that

wide-aperture nonlinear interferometers can be used to detect interesting autowave properties in conditions of unstable stationary states and can be employed to monitor the space-time development of self-modulation and dynamical chaos.

Weakly Nonlinear Solitons in a Lattice Model of a One-Dimensional Uniaxial Magnet

18620185C Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 34 No 3, Mar 89 pp 434-440

[Article by A. N. Goncharuk]

[Abstract] This study proves the existence of weakly nonlinear dynamical two-parameter solitons for the case of a lattice model of a one-dimensional uniaxial magnet with ferromagnetic ordering. The corresponding solution is found in explicit form and analyzed. Both single-ion and interion anisotropy are accounted for. The study demonstrates that accounting for both the discreteness of the magnet and the one-ion anisotropy makes it possible for a new type of soliton to exist.

Effect of Dissipation on Stimulated Raman Scattering of Solitons

18620231A Tashkent IZVESTIYA AKADEMII NAUK UzSSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 1, Jan-Feb 89 pp 58-61

[Article by F. Kh. Abdullayev, G. Kh. Tartakovskiy, and S. Sh. Tadzimuratov, Department of Thermophysics, UzSSR Academy of Sciences]

[Abstract] The soliton solutions to the system of equations which describe stimulated Raman scattering, solutions obtained by F. Y. Chu and A. C. Scott (PHYSICS REVIEW A12, No 5, 1975) by the method of inverse scattering theory and indicating the possibility of pulse compression, are corrected for dissipation in the first approximation of perturbation theory with the aid of Gelfand-Levitan-Marchenko equations. The profiles of pump and Stokes pulses calculated accordingly with the small parameter epsilon equal to 0.3 indicate that already moderate dissipation distorts these pulses, a soliton acquiring a "tail" and its center shifting. Figures 1; references 7: 3 Russian, 4 Western.

Effect of Anisotropy on a New Type of Triphonon Spectrum

18620181C Leningrad FIZIKA TVERDOGO TELA in Russian Vol 31 No 2, Feb 89 pp 32-34

[Article by O. A. Dubovskiy and A. V. Orlov]

[Abstract] This study demonstrates that additional vibrational branches corresponding to highly-excited triphonons may exist in crystalline systems that are more complex than those examined previously. The study determines the dispersion law of highly-excited triphonon vibrational states and the position of the corresponding terms in the spectrum. The terms of the triphonon vibrations are found to be near both boundaries of the biphonon plus free phonon band and form together with the band of entirely dissociated triphonon states and the term of the triphonon ground state a complex multiplet structure in the vicinity of the three-phonon vibration frequencies.

Laser-Induced Fluorescence Intensities and the Force of the AO^+_u-$X1^+_g$ Electron Transition of the $^{130}Te_2$ Tellurium Dimmer System

18620171A Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 66 No 1, Jan 89 pp 77-80

[Article by Ya. A. Kharya, N. Ye. Kuzmenko, A. V. Stolyarov, and R. S. Ferber]

[Abstract] This study carries out the first quantitative measurements of the relative intensities of the AO^+_u-$X1^+_g$ system in order to determine the dependence of the electron transition force on the internuclear distance in the *r*-centroid approximation. The relative intensities are measured in the vibronic-rotational spectrum of the AO^+_u-$X1^+_g$ intercombination transition of the $^{130}Te_2$ tellurium dimmer system. The study also calculates the potentials of the combining states, the Franck-Condon factors and the *r*-centroids. The relative intensities of the AO^+_u-$X1^+_g$ transition of the $^{130}Te_2$molecule are reported for the R-, Q-, and P-branches together with the Franck-Condon factors and the *r*-centroids for the same respective branches. The study discusses the change in the electron transition force from the R-centroid for the AO^+_u-$X1^+_g$ system. This study also determined and reported the absolute value of the intercombination electron force. The study carried out direct measurements of the intensity ratio of the most intense and the closest lines for the AO^+_u-$X1^+_g$ system.

A Magnetooptic Method of Converting Optical Radiation Polarization

18620171B Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 66 No 1, Jan 89 pp 185-189

[Article by S. A. Gudenko, Ye. A. Podpalyy, V. S. Smyelova, and A. P. Gubaryev]

[Abstract] This article considers a magnetooptic technique for converting optical radiation polarization, specifically for conversion of a beam with random cross-sectional polarization into a beam of homogeneous circular or elliptical polarization. The conversion process is implemented by means of a magnetooptic grating. Radiation is defracted by such a structure due to polarization, phase, and amplitude modulation. The analysis considers the specific parameters of the grating band structure in the far field of the zeroth diffraction order that will produce a beam of circular polarization. The study carries out a theoretical analysis of the magnetooptic polarization conversion technique together with an experiment to verify the calculations using Bi-containing garnet magnetooptic film specimens. The parameters of the two fabricated

specimens are reported. It is determined that a transparency can be employed at 1.06 mcm to increase the optimum thickness of the magnetic film.

The Kinetics of the Wavefront Restoration Process in Resonance Dynamic Holography

18620171C Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 66 No 1, Jan 89 pp 200-204

[Article by T. V. Smirnova and O. Kh. Khasanov]

[Abstract] This study employs a numerical analysis of the evolution of all radiation components to investigate in detail the components of inverted and restored wavefronts as a function of the area of the object and reference waves. In this dynamic hologram read-write scheme the object beam is translated along the lateral surface of the specimen in the direction of the z axis, thereby driving the system of impurity centers into a superposition state. The reference wave pulse is injected in this same direction. The analysis suggests that in the case of weak dispersion and small diffraction corrections there is incomplete locking of the phases of the interacting waves which stabilizes the energy exchange process between the reading beam and the diffraction responses. The study also determines that small diffraction corrections do not produce phase distortions in the restored waves.

Violation of Transversality and Electromagnetic Field Energy Transfer in Coherent Light Beams

18620171D Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 66 No 1, Jan 89 pp 220-222

[Article by A. Ya. Bekshaev and V. M. Grimblatov]

[Abstract] This study carries out a theoretical analysis to determine the role of violation of transversality in radiation propagation, specifically its role in determining the kinetics of energy transfer in a light beam. The theoretical analysis based on the derived equations suggests that energy is conveyed along the normals to the wavefront which are the current lines; this process occurs independent of the gain or loss inhomogeneity. This is consistent with the known shift of the amplitude distribution of light beams to the high gain region since beam evolution is determined by both the direction and modulus of the energy flux function and the gain inhomogeneity.

A New Plasma Atomization Source Based on a Flame and Electric Arc and Its Application to Atomic Spectrometry

18620186A Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 50 No 1, Jan 89 pp 154-158

[Article by Ye. D. Prudnikov]

[Abstract] This study examines the fundamental possibility for the analytic application of a new plasma flame atomization source based on a d.c. flame and arc. The new plasma atomization and excitation source employs an extended analytic probe, has a high operating temperature and good stability as well as low detection thresholds of the elements. Test results on this unit demonstrates that this plasma atomization source is comparable to high-temperature plasma with respect to detection thresholds. This demonstrates the high atomization efficiency of elements that are difficult to atomize and suggests that the unit can be broadly employed for spectral analysis of such elements. The need for further research into the performance and analytic capacities of this new flame-plasma atomization source is noted.

UDC 537.525:538.7

Effective Stagnation of Plasma Stream at Boundary of Magnetic Cavity

18620227B Moscow FIZIKA PLAZMY in Russian Vol 15 No 6, Jun 89 pp 765-767

[Article by B. A. Nechayev and A. V. Peshkov, Scientific Research Institute of Nuclear Physics at Tomsk Polytechnic Institute imeni S. M. Kirov]

[Abstract] Stagnation or reflection of a cold plasma stream upon its reaching the boundary of a magnetic cavity is analyzed, considering that the magnetic field intensity everywhere inside such a cavity is lower than at its boundary. An experiment was performed with argon as plasma generator, a pulse discharge of millisecond duration with a power of 1-3 MW in crossed electric and magnetic fields triggering plasma formation. Measurements have yielded data on the profiles of a quasi-steady collisionless shock wave propagating from the plasma source through a magnetic cavity beyond it, also the transients of electron temperature and plasma density inside and outside a magnetic cavity. These data reveal that a magnetic cavity expands, its boundary moving outward, even as the power supplied by a discharge pulse decreases toward the end of its duration. This indicates that energy is being stored in a magnetic cavity. It also indicates the feasibility of effective plasma confinement in a magnetic cavity. Figures 4; references 7: Russian.

UDC 533.9

Electrical Conductivity of Nonideal Cesium Plasma

18620228A Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 27 No 3, May-Jun 89 pp 417-424

[Article by A. A. Borzhiyevskiy, V. A. Sechenov, and V. I. Khorunzhenko, Moscow Institute of Engineering Physics]

[Abstract] An experimental study of Cs plasma was made, for a determination of its electrical conductivity. A plasma of 30 mol.pct Cs and 70 mol.pct Ar mixture was produced by compression of vapor and then expanded in an adiabatically heatable tube. Measurements were made first with four probes, this method being less sensitive to formation of a Cs-condensate film on the tube wall than the resonator-Q method with an inductance coil and its error being correspondingly much smaller. The influence of this condensate film and also that of a growing cold plasma layer with an anomalously high electrical conductivity was subsequently eliminated by use of a guard electrode for measurements with only two probes. Voltage pulses with a stepwise increasing amplitude were applied to the guard electrode. The potential of the floating probe reached the level of the guard electrode potential asymptotically close after a time delay depending on the circuitry, the other probe being grounded. Readings were taken with the plasma temperature varying over the 2000-3000 K range, the vapor pressure varying over the 10.5-6 MPa, and the plasma nonideality index $e^2/(kTr_D)$ (r_D- Debye radius, T- absolute temperature, k- Boltzmann constant, e- electron charge) varying over the 0.2-1.9 range. The readings were negligibly influences by presence of the Ar component, owing to its much higher ionization potential and much smaller electronic scattering cross-section of its atoms. Figures 5; references 17: 13 Russian, 1 Hungarian, 1 East German, 1 Western.

A Theory of Cherenkov Radiation of Plasma Waves by a Charge Traveling in a Magnetically Active Plasma

18620190A Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 34 No 4, Apr 89 pp 554-558

[Article by A. G. Boyev and M. Yu. Lukyanov]

[Abstract] This study carries out a detailed analysis of the angular and frequency properties of the Cherenkov radiation of plasma waves as well as their dependences on plasma parameters, external magnetic field strength and charge velocity. This analysis is intended to determine the possibility of using the mechanism of Vavilov-Cherenkov radiation for formulating a theory of Jovian sporadic decameter radio emission. Assuming that plasma waves transform into electromagnetic waves due to the regular ionospheric inhomogeneities and this occurs without altering the frequency, the experimental picture derived in this study for the angular and frequency characteristics is accurately described by the properties of Cherenkov radiation. The experimental parameters of the decameter radiation given in the study can be explained by the generation mechanism at a maximum charged particle concentration in the Jovian ionosphere of 5×10^6 to 17^7 cm^{-3} at a plasma electron temperature of 10^3 to 10^5 K, a charge velocity of 10^{-1} to 10^{-2} and a magnetic field strength of eight to 10 G.

Characteristics of Magnetization Relaxation During Initial Period and Effect of Magnetic Field on Flux Creep in $Bi_2Sr_2CaCu_2O_x$ Single Crystals

18620239B Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 50 No 2, 25 Jul 89 pp 81-84

[Article by V. V. Moshchalkov, A. A. Zhukov, and L. I. Leonyuk, Moscow State University imeni M. V. Lomonosov, V. D. Kuznetsov and V. V. Metlushko, Moscow Institute of Chemical Engineering imeni D. I. Mendeleyev]

[Abstract] An experimental study of $Bi_2Sr_2CaCu_2O_x$ single crystals was made involving measurement of the magnetic moment as a function of time in the zero-flux-creep mode, for the purpose of determining the dependence of its relaxation rate on the magnetic induction and on the temperature. Measurements were made with a SQUID magnetometer, with the magnetic field first parallel and then perpendicular to the c-axis of a crystal, the magnetic induction being varied over the 0-0.300 T range at fixed temperatures and the temperature being varied over the 1.8-300 K range at fixed levels of magnetic induction. The data reveal two stages of magnetic relaxation, nearly exponential fast initial relaxation followed by logarithmic slow relaxation and the transition occurring in a much stronger perpendicular than parallel magnetic field. The dependence of the relaxation rate on the magnetic induction is found to be characterized by a sharp peak, the maximum relaxation rate becoming higher and shifting to higher magnetic induction as the temperature is lowered. Such a peaking of the relaxation rate is attributable to a topological change in the distribution of shielding current and thus also in the distribution of Abrikosov vortices. Figures 3; references 5: 2 Russian, 3 Western.

UDC 534.16:539.2

Collective Oscillations of Interphase Boundaries in High-Temperature Superconductors

18620225A Kiev FIZIKA NIZKIKH TEMPERATUR in Russian Vol 15 No 6, Jun 89 pp 614-620

[Article by Yu.A. Kosevich, All-Union Scientific Research Center for Study of Surface Properties and Vacuum, Moscow, and Ye.S. Syrkin, Institute of Low-Temperature Engineering Physics, UkSSR Academy of Sciences, Kharkov]

[Abstract] Formation of surface waves with a half-power dispersion law in an A-B-A triple-layer two-phase solid medium comprising a periodic array of twins B embedded in the parent high-temperature superconductor metal-oxide phase A is analyzed, such waves constituting the acoustic analog of two-dimensional plasmons. The conditions for and the range of their existence are established, considering specifically low-frequency oscillations of both interlayer boundaries generating waves with a space period much larger than the period of the phase B structure so that the latter can be approximated as a domainless one of a homogeneous material with effective density and moduli of elasticity. Both phases are treated as acoustically similar disoriented crystalline media, inasmuch as orthorhombic distortion just prior to tetragonal-to-orthorhomic transition is small. The requirement for existence of surface acoustic waves is shown to be either phase A or phase B, or both phases, be anisotropic with respect to elasticity. As a special case are considered surface acoustic waves polarized in a sagittal plane. The authors thank A.M. Kosevich for helpful comments and A.S. Kovalev for discussion of the results. Figures 1; references 13: 6 Russian, 7 Western.

UDC 538.945

Critical Temperature for Superconductor Superlattices

18620225B Kiev FIZIKA NIZKIKH TEMPERATUR in Russian Vol 15 No 6, Jun 89 pp 636-644

[Article by V.M. Gvozdikov, Kharkov State University imeni A.M. Gorkiy]

[Abstract] Superconductor superlattices with S-N-S or S-I-S structures are considered and the dependence of their critical temperature on the structural parameters is established in accordance with the Ginzburg-Landau theory. The influencing parameters include not only the number of layers and their thicknesses but also two lengths which characterize respectively the tunneling effectiveness and the unpairing effectiveness of the interlayer. The corresponding Ginzburg-Landau equation for the order parameter in each S layer is solved for appropriate boundary conditions which relate the two respective values of the order parameter in the two S layers separated by an N or I interlayer. The critical temperature is found to become higher as the number of S layers is increased and the links between them are strengthened, the relative change increasing as the thicknesses of these layers are decreased. The author thanks M.A. Obolenskiy, N.Ya. Fogel, and especially L.I. Glazman for the many discussions. Figures 2; references 26: 11 Russian, 15 Western (1 in Russian translation).

Study of Mixed State in $YBa_2Cu_3O_{6.9}$ Superconducting Ceramic With Aid of Polarized Neutrons

18620222A Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 59 No 6, Jun 89 pp 186-187

[Article by M.P. Volkov, R.P. Dmitriyev, N.K. Zhuchenko, V.A. Trunov, V.K. Fedotov, and R.Z. Yagud, Institute of Engineering Physics imeni A.F. Ioffe, USSR Academy of Sciences, Leningrad]

[Abstract] An experimental study of the mixed state in high-temperature superconducting $YBa_2Cu_3O_{6.9}$ ceramic was made by the method of polarized neutrons, a specimen of this material having been produced from a

mixture of Y_2O_3, BaO, CuO powders sintered at 950°C and subsequently annealed for 80 h in an oxygen stream. The powder mixture was then compacted under a pressure of 2 kbar and the compact again heat treated at 930°C for 30 h in an oxygen stream. The density of the specimen was 5.2 g/cm^3, its grains were not larger than 0.040 mm in diameter, its symmetry was rhombic (Pmmm), and its critical temperature defined as center point of the superconducting transition range was within 88-92 K on the basis of magnetic susceptibility measurements. A neutron beam was passed through the specimen in a magnetic field of 5-16 kOe intensity at 4.2 K temperature, magnetization of the specimen having begun to become nonlinear at 0.8 kOe. Its magnetization rose to a maximum at 5 kOe and then slightly decreased. The polarization of neutrons dropped to a minimum at 5 kOe and remained approximately at this level without an appreciable change during passage through the specimen, this being attributable to deflection of the neutron beam from the direction of the external magnetic field. Figures 1; references 6: 1 Russian, 5 Western.

Electron-Phonon Interaction in Bi-Sr-Ca-Cu-O Single Crystals With Different Critical Superconducting Transition Temperatures

18620210B Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 49 No 9, 10 May 89 pp 510-512

[Article by S. I. Vedeneyev and V. A. Stepanov, Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences]

[Abstract] An experimental study of tunneling in single crystals of $Bi_2Sr_2CaCu_2O_{8-x}$ high-temperature superconducting material was made with specimens of its two phases, their respective critical temperatures being 65 K and 23 K based on the temperature dependence of the energy gap. Their energy gaps at 4.2 K were 20 meV and 7.2 meV respectively. The current-voltage characteristic of respective $Bi_2Sr_2CaCu_2O_{8-x}$-Nb tunnel "point" junctions was measured, whereupon its first derivative dV over dI (V) and second derivative d^2I over dV^2 (V) were calculated. A correlation between both derivatives and the spectral density of electron-phonon interaction has been established as a result, the phonon spectrum and the interaction spectrum having been reconstructed from tunneling and neutron scattering data. The results indicate a significant role of electron-phonon interaction in formation of electron pairs and in determining the superconducting transition temperature. The authors thank M. O. Ptitsyn for assistance in computer processing of the experimental data and B. Renker for making the phonon spectrum of Bi-Sr-Ca-Cu-O material available for publication. Figures 3; references 6: 3 Russian, 3 Western.

UDC 02;07;12

Feasibility of Quantum Magnetometer Based on Principle of Combination-Frequency Oscillator

18620206B Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 15 No 8, 26 Apr 89 pp 1-4

[Article by M. V. Balabas, V. A. Bonch-Bruyevich, and S. V. Provotorov]

[Abstract] A quantum magnetometer is proposed which includes a mixer of combination-frequency signals from an internal oscillator and amplified signals from the induction transducer, the mixer feeding back to the transducer through a phase shifter. This scheme eliminates the problem of automatic frequency controls in the case of large frequency mismatch between an external oscillator and the measured EPR-line as well as the problem of monitoring the EPR-line. The combination-frequency oscillator is a difference-frequency one operating at the two outer lines ^{39}K and ^{87}Rb of the four lines which belong to the state with F equal 2, signals from only these two lines and from no other line being generated in the EPR-spectrum and appearing in the feedback loop. The instrument was tested at two levels of magnetic induction, 0.050 mT and 0.070 mT, with the ^{87}Rb isotope ($71.8.10^8$ Hz/T^2). The readings can be converted into a magnetic induction proportional to half the sum of both frequencies with a proportionality factor characterizing the active substance and including up to third-order field corrections. Figures 2; references 5: Russian.

UDC 05.4

Thin Films of Bi-Sr-Ca-Cu-O High-Temperature Superconductor Material Produced by High-Frequency Magnetron Sputtering

18620206C Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 15 No 8, 26 Apr 89 pp 89-94

[Article by V. N. Alfeyev, O. K. Andreyev, S. G. Volgin[kh], T. I. Gromova[kh], and G. B. Petrov]

[Abstract] Thin films of $Bi_2Sr_{2.2}Ca_{0.8}Cu_2O_y$ ceramic were grown on α-Al_2O_3 substrates (sapphire single crystals) and on MgO substrates by high-frequency magnetron sputtering, both substrate materials being characterized by a low dielectric permittivity. The target material for sputtering was synthesized from a mixture of chemically pure Bi_2O_3, $SrCo_3$, and CuO powders in the appropriate ratio. The mixture was first sintered at 800°C for 6 h, reground and again sintered at 850°C for 6 h, reground and again sintered at 870°C for 6 h, reground and passed through a sieve of 0.5 mm mesh size. The fine fraction was compacted under a pressure of 500 kgf/cm^2 and sintered at 870°C for 8 h. Subsequent x-ray examination revealed a complete reaction of all components into a single $Bi_2Sr_{2.2}Ca_{0.8}Cu_3O_y$ phase with a trace of $Bi_2(Sr,Ca)_4Cu_3O_y$ as the only impurity. Sputtering was done in a 500 W

magnetron at a frequency of 13.56 MHz, in an argon atmosphere under a pressure of 2 Pa, with the target automatically biased to -200 V and with the substrates at a temperature of 200°C. The amorphous films thus grown to 0.0015-0.002 mm thickness at a rate of 1 mm/h were annealed in air at temperatures up to 880°C. Their surface resistivity was found to decrease with rising temeprature, a small intermittent upward jump at 525°C and change to a milder slope at 685°C indicating phase transformations, and was found to increase upon cooling. The superconducting transition temeprature for films annealed at 870°C was, moreover, found to have shifted downward, this degradation being attributable to interaction with the substrate material (α-Al_2O_3 or MgO) at a temperature above 850°C. The authors thank O. D. Pustylnik for measuring the electrical resistance of the films at low temperatures. Figures 2; references 14: 4 Russian, 10 Western.

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